Part 1:

Archaeological Context

ARCHAEOLOGICAL PERSPECTIVES ON WILD RICE

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ABSTRACT

Wild rice is a vital aspect of human history in the Upper Midwest. Evidence for expansion of wild rice beds is first seen in the paleoecological record starting approximately 4000 years ago. Subsequent periods of intensified rice use and advances in rice processing technology have long been interpreted by archaeologists as catalysts for cultural changes that span thousands of years. Archaeological remains of parching features and threshing pits are significant indicators of these transformations, as are the preserved remains of the grain itself. Analysis of phytoliths (microscopic plant silica bodies) from charred food residues inside ancient cooking pots allows the identification of cereal food types, providing a recent advance in the archaeological study of wild rice use. This paper presents an overview of archaeological data regarding wild rice utilization, with an emphasis on the Mississippi Headwaters, Mille Lacs, and Red Wing areas of Minnesota.

INTRODUCTION

Wild rice has long held an undisputed and prominent role in the human history of the Upper Midwest. The early European explorers were amazed about the quantities of wild rice they saw and often remarked about the grain and its role in the societies of the American Indian people they encountered. Father Hennepin described the wild rice he observed at Mille Lacs in 1680:

> The lake spreads over vast swamps where wild rice grows. Wild rice is also found in many other places as far as the end of Green Bay. This kind of grain grows in swampy land without being sown. It resembles oats but tastes better and has longer stems and stalks. The Indians gather it in season, the women binding many stalks together with basswood bark to prevent its being entirely eaten by the flocks of duck and teal found in the region. The Indians lay in a store of it for part of the year, to eat when their hunting season is over (Cross 1938).

The clear importance of this grain in such writings is of great interest to archaeologists, who have investigated its past distribution and availability, and modeled its role in cultural transformations. Its prevalence, storability, and predictable harvest have also invited comparison with the domestication of plant foods and the origins of agriculture, topics that are pivotal to human history in many parts of the world (e.g., Johnson 1969a, 1969b; Gibbon and Caine 1980; Anfinson and Wright 1990; Thomas 1995).

Archaeology is the study of the human past through material objects. By definition, these artifacts have survived the passage of time and are found by the archaeologist. Typical sources of archaeological information are broken pieces of inorganic materials, such as pottery or stone tools. The vast majority of artifacts recovered from archaeological sites are objects that were either intentionally discarded (garbage) or, to a lesser extent, lost. Therefore, an archaeologist trying to learn of the past is left with a group of objects that may marginally, at best, represent what activities actually took place at a site. We know that many tools and other objects used in the past were made of plant materials, such as wood and fiber, and these would not survive the passage of time even if they were left behind.

Regarding wild rice and ricing technology in particular, very little physical evidence has been left behind for the archaeological record. Canoes, poles, and ricing sticks for gathering rice are made of wood and so are unavailable to the archaeologist except under the most exceptional of circumstances. The same is true for most of the equipment used in parching rice, as described by Alfred Jenks nearly a century ago. He writes:

> Not many mechanical implements are used in curing the rice. It is sun-cured on blankets, on birch bark, and on scaffolds of sticks. It is fire-cured and parched in kettles. Scaffolds are covered with sticks, cedar-slabs, reeds, grass, and mats of basswood and cedar bark. These scaffolds are at times nearly surrounded by a hedge of pine or cedar branches. A paddle is used to stir the grain while parching in the kettle, and also at times while drying on the rack (Jenks 1901).

As Jenks' account illustrates, an archaeological search for wild rice, and changes in the human use of wild rice over time, requires an examination of secondary sources and a mixture of paleoecological and traditional archaeological methods. This paper is intended to introduce the contributions and limitations of archaeology in wild rice research. Its geographic focus is the Mille Lacs locality of east central Minnesota (Johnson 1984; Mather 2000), where wild rice utilization spanning thousands of years is a primary topic of archaeological interest. A brief overview of archaeological research related to wild rice is presented first, with consideration of potential wild rice data sources in the archaeological record and their role within archaeological theory and interpretation. Much of the discussion focuses on archaeological features, such as ricing jigs and parching areas, and then moves to phytolith analysis of charred food residue from ancient pottery vessels. The latter topic is a significant advance that draws from paleoecological research techniques. Wild rice plant macrofossil and pollen data are also discussed in brief.

WILD RICE RESEARCH

Much of the impetus for archaeological investigations of wild rice use can be attributed to Elden Johnson, former State Archaeologist and professor at the University of Minnesota. Johnson's initial research (e.g., 1969a, 1969b) focused on the antiquity of rice and ricing and their role in the more than 10,000 years of human history in Minnesota. The Mille Lacs area was a primary focus of Johnson's research from the 1960s into the early 1980s, during which time wild rice held a prominent role. The University of Minnesota's Mille Lacs Research Project, as it was called, was a pioneering effort in Minnesota archaeology in that it focused the efforts of a multi-disciplinary team of researchers in one region (Johnson 1984, 1985; Birk and Johnson 1988; Mather 2000).

Johnson's excavations, and those of his colleagues and students, were the first in Minnesota to systematically attempt recovery of archaeological plant remains. By that time, the soil from archaeological excavations was typically screened through ¼-inch mesh to recover artifacts, but small plant and animal remains would still be lost. Collection of soil samples helped to correct this bias, as the collected sediments could be carefully dispersed in water or washed through a fine mesh screen to recover charred plant remains and other small artifacts. These techniques can be focused on a particular feature, such as a ricing jig or storage pit, but are best used systematically across an excavation area. During the course of the Mille Lacs Research Project, ricing features and/or wild rice grains were recovered at the Cooper (21 ML 9/16), Petaga Point (21 ML 11), Wilford (21 ML 12), and Old Shakopee Bridge (21 ML 20) Sites, among others (Bleed 1969; Gibbon 1976; Schaaf 1981; Johnson 1984, 1985; Bailey 1997). Although the period of occupation varies between these sites, they all contain components dating to the Late Woodland period (ca. A.D. 600-1700), and the wild rice finds can be attributed (at least in part) to the eastern

Dakota people. As one example, the prevalence of wild rice among the plant macrofossils recovered from the Wilford Site (see Figure 1) attests to the importance of the grain during the Shakopee and Bradbury phases (ca. A.D. 1300-1750) at Mille Lacs.

PALEOECOLOGY

The paleoecology of wild rice was an important aspect of the University of Minnesota's Mille Lacs Research Project. John McAndrews, now Professor Emeritus at the University of Toronto, conducted pollen coring at that time to supplement the archaeological investigations. In terms of human history, there are two vital points from McAndrews' research. The first is that wild rice has been present in Minnesota throughout the Holocene. Second, its availability and abundance are widely variable. In general, wild rice has flourished in the later Holocene, with expansion of many rice beds beginning from 4000 to 2000 years ago (McAndrews 2000). It is also important to remember that wild rice was once present beyond its present range. Although it was most prevalent in the lakes of northern Minnesota, Wisconsin, Manitoba, and northwest Ontario, wild rice could once be found across much of eastern North America, including the Minnesota River and areas of the adjacent states to the south (Thomas 1995; Anfinson 1997).

The similarity of wild rice pollen to that of other grasses has been a significant obstacle to tracing the natural history of wild rice through pollen analysis (Yourd 1988; Huber, this volume). Recent re-examination of the Mille Lacs cores by McAndrews (2000) has included measurement of the Graminae pollen, with the conclusion that wild rice can be reliably distinguished from other grasses. Radiocarbon dates associated with the pollen zonation indicate that expansion of wild rice beds in Lake Ogechie (in the Mille Lacs chain of lakes) began approximately 3500 years ago (McAndrews 2000).

RICING FEATURES

As mentioned previously, an event must leave a physical remnant to become part of the archaeological record. When thinking of such activities associated with wild rice use, ricing jigs, parching features, and storage pits hold the most promise. Storage pits and ricing jigs can leave actual holes in the ground, or at least can be defined by archaeological excavation if they are old enough to have become filled in. Clay-lined, basin-shaped ricing jigs were identified during Leland Cooper's initial excavations at the Cooper Site (21 ML 9/16). (See Figure 2.) Similar features are described at the Old Shakopee Bridge Site (21 ML 20), where nine ricing jigs were recorded as "orange, roughly circular 'halos' filled with dark brown soil." A triangular projectile point and some preserved birchbark were recovered from one of the features (Gibbon 1976). Such features are also documented by Valppu (this volume) at the Big Rice Site in northeastern Minnesota. It is important to note that the function of these clay-lined features as ricing jigs has not been independently confirmed. It does seem to be a reasonable explanation, nonetheless, and it is presumed that the clay is the durable remnant at the bottom of a former pit or basin. These features, at least at Mille Lacs, can be attributed to the Dakota presence prior to European contact.

Ricing jigs are also known without clay linings. In fact, shallow, basin-shaped holes are often visible on the ground surface at archaeological sites located in areas where wild rice harvesting could be expected. Deeper holes are also frequently encountered in the same areas. Some of these combined feature types probably were ricing jigs, and some were probably storage pits, but there has not been a systematic effort to distinguish between the two. Examples of such pit/basin features are known at many archaeological sites at Mille Lacs, such as the Old Shakopee Bridge (21 ML 20) and the Pit (21 ML 48) Sites on Lake Onamia and the Cooper (21 ML 9/16), Wilford (21 ML 12), and Ricing (21 ML 5) Sites on Lake Ogechie. Excavation into these features at the Cooper Site,

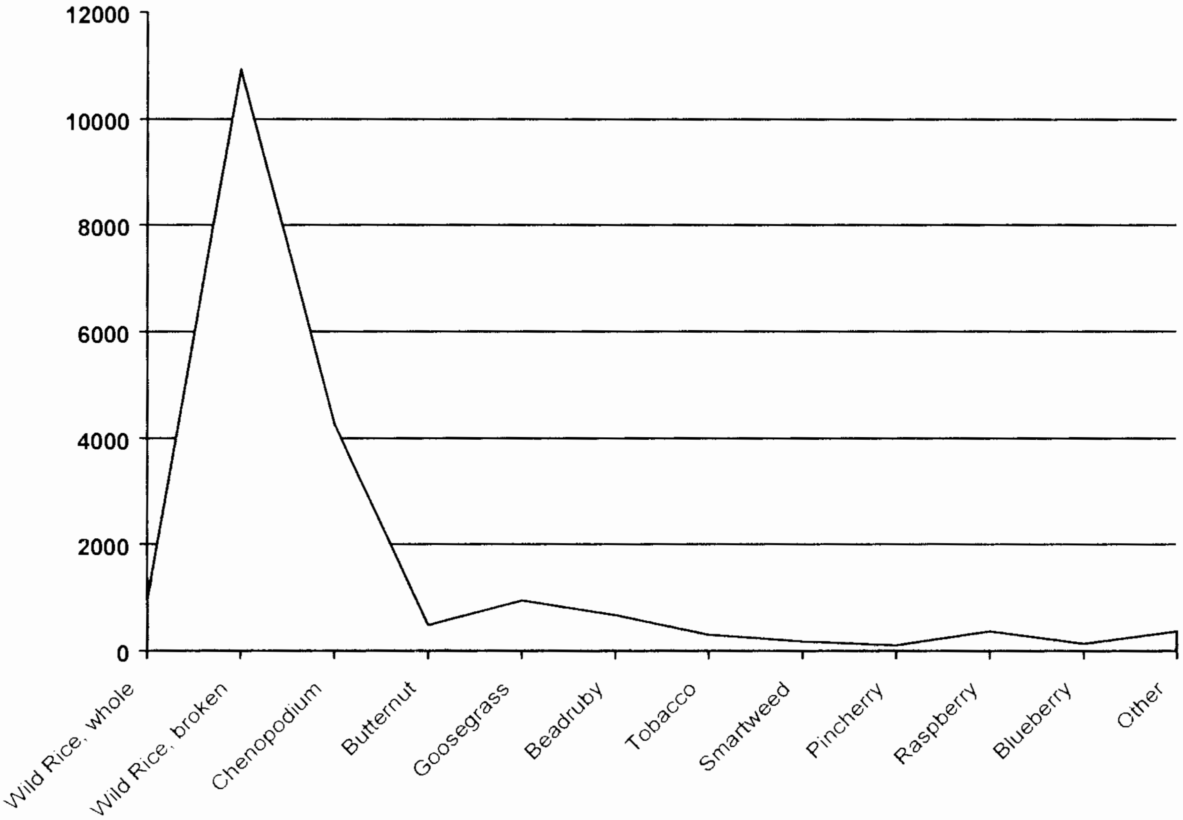

Figure 1: Plants identified from cultural features at the Wilford site (21ML12). Compiled from data in Bailey (1997).

Figure 2. Clay-lined ricing jig at the Cooper Site (21 ML 9/16). Photo courtesy of Christy Hohman-Caine.

the Pit Site, and on the west shore of Mille Lacs Lake have produced historic artifacts, some as recent as the middle twentieth century (Johnson 1984, 1985; Gibbon 1976; Mulholland et al. 1993; Peterson 1982). These features can be attributed to Ojibwe ricing activities.

Parching features are also found at many Mille Lacs sites. These features are generally oblong (ca. 2 x .5 meters) and have red/orange soil coloration. The edges are amorphous and contain concentrations of charcoal. Peter Bleed (1969) describes a "rice-parching ring" as "one of the most interesting, if problematical, finds made at Petaga Point." The charcoal lenses in that feature contained charred rice grains and historic seed beads. Wilford (1949) reports a similar feature at the Vineland Bay Site (21 ML 7), then known as the Kathio School Site.

At the south end of the trench was a fire hearth dug shallowly into the subsoil, which contained charcoal. The earth beneath the charcoal was burned to a reddish color. At the eastern edge was a circular pit, pit 2, the base of which was one foot below the floor of level 5. It contained bits of charcoal (Wilford 1949).

The Vineland Bay feature also contained historic materials, including part of a wood burning stove. A complete bear cranium was found directly over the feature.

It is important to note that parching features are formed differently than the feature types discussed above. The archaeological remains of storage pits and ricing jigs consist of the physical hole itself (and its fill, if any). Parching features, on the other hand, are more of a reflection of the activity that took place. The burned color, which defines the limits of the feature, is created by the dispersal of heat from the parching fires through the surrounding soil. A series of these distinctive burned red/orange features (see Figure 3) have recently been excavated at the Crosier (21 ML 33) and Van Grinsven (21 ML 37) Sites (Mather and Nicholas 2000a, 2000b). Paleobotanical analysis by Seppo Valppu (2000) revealed the presence of wild rice and domestic *Chenopodium* (goosefoot) in the charred areas. One wild rice grain was charred with its husk intact. (See Figure 4.) None of the features contained historic artifacts, but radiocarbon dates extended into the historic period, and it can be concluded that these features are also related to Ojibwe ricing. It is tempting to suggest that the burned reddish strata of these features are the result of a change in rice parching technology. Perhaps the color and configuration of these features reflect the adoption of metal kettles for parching.

The interconnected role of these varied feature types relative to wild rice becomes clear in a description of eastern Dakota rice processing in the early nineteenth century:

> The rice was then dried in the sun or on scaffolds with fires underneath. Next, it was parched by being heated in a kettle over a fire and put into circular pits about two feet deep and two feet wide. Young men washed their feet, put on new moccasins, and trod on the rice in the pits until it was hulled. The women then placed it on a robe that they shook to separate the chaff from the kernels of rice. Rice not immediately consumed was stored in well-concealed pits or caches lines with dry grass and bark (Spector 1993).

PHYTOLITHS

A new technique has been added to the repertoire of research procedures that can be applied to tracing wild rice use. Thompson and Mulholland (1994) have demonstrated the feasibility of tracing the use of North American grasses through phytolith analysis of food residues. Phytoliths are microscopic silica cell walls produced by some plants. The chaff encasing or holding the seeds of grasses are especially prolific producers of these silica cells. Assemblages of these silica bodies can be

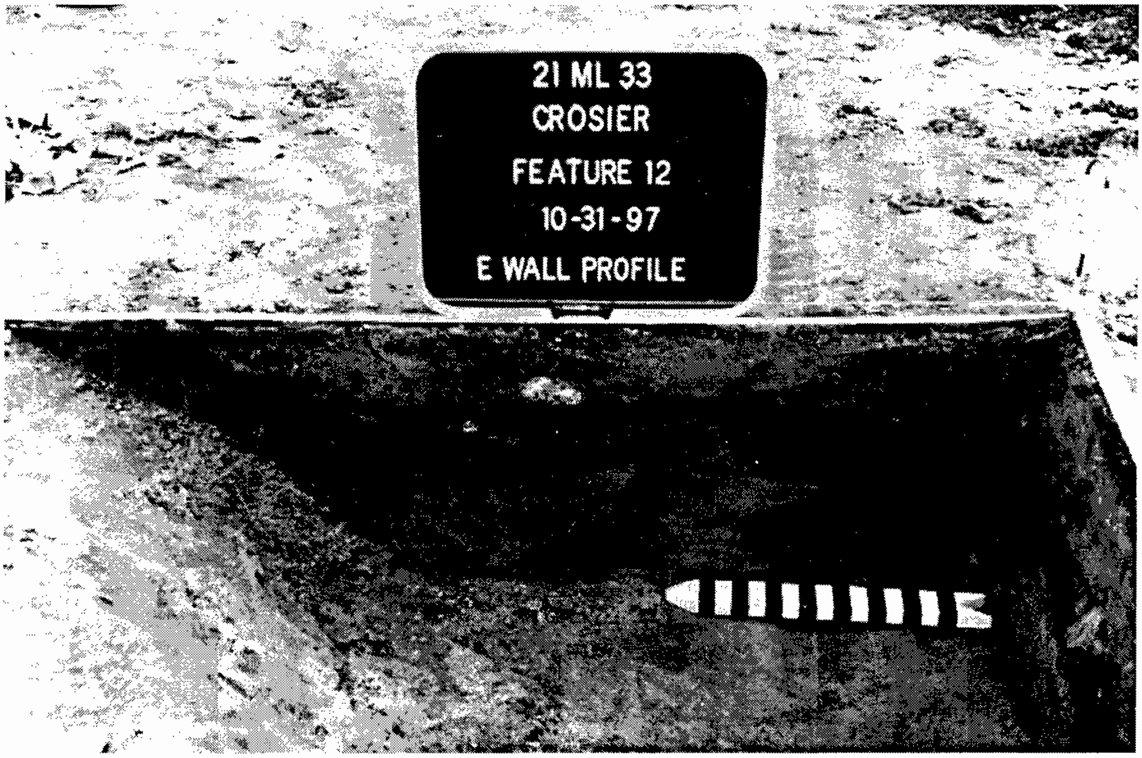

Figure 3. Excavation of a rice parching feature at the Crosier Site (21 ML 33). Photo courtesy of the Lake Onamia/Trunk Highway 169 Data Recovery Project.

Figure 4. Scanning electron micrograph of wild rice grain charred with the husk intact, recovered from a rice parching feature at the Crosier Site (21 ML 33). Photo courtesy of the Lake Onamia/Trunk Highway 169 Data Recovery Project.

taxonomically significant. In addition, these cells are very durable and resist both the processes of decay, which impact organic plant parts, and the heat to which the cells are subjected during the process of cooking.

This analytical technique grew from research at the Shea Site (32 CS 101), a village site in eastern North Dakota. The site contained pottery styles associated with the Missouri River corn agricultural villages and the Sandy Lake complex, which is associated with wild rice use in Minnesota. This led to questions of whether this was an agricultural village, and/or whether wild rice was a significant resource there. Plant macrofossils, which might normally have been studied to address this question, were not recovered in abundance from this site. Thompson and Mulholland (1994) reasoned that the processing of grasses for food would not result in perfect separation of seed and chaff, and that the incorporation of abundant silica bodies into grass foods (including corn and wild rice) would result. Food residue is often found baked on the interior walls of pottery. Removing the organic portion of this residue results in an assemblage of silica bodies that can be studied. Much of the previous work in phytolith studies was concerned with its potential as an indicator of past environments (Rovner 1983). Another important focus has been on the development of the taxonomies needed to make phytoliths a useful research tool (Mulholland and Rapp 1992).

Mulholland (1989) had previously demonstrated that corn produced a silica body assemblage that was distinct from wild grasses in North Dakota. This research involved differentiating between the assemblage of phytoliths from wild rice chaff and corn glumes and cupules. At the Shea Site, it was found that corn, rather than wild rice, was represented in the food residues. The analysis did provide the framework for future research on wild rice through food residues, however. At the Ogema Geshik Site in the Mississippi Headwaters area (Thompson et al. 1994, 1995), a food residue sample was analyzed that yielded a phytolith assemblage with a particularly striking resemblance to the phytolith assemblage from wild rice chaff. It is not surprising that a chaff phytolith assemblage should be found in a pot used for cooking wild rice. Chaff is a prolific producer of phytoliths, and enough chaff remains after processing wild rice to account for the presence of a chaff phytolith assemblage. In fact, Densmore (1928) noted, "The chaff from this treading [processing grains to remove chaff] was usually kept and cooked similarly to the rice, having much the flavor of the rice, and being considered something of a delicacy."

Recently, food residues were analyzed from four pottery vessels recovered from archaeological sites at and near Mille Lacs (Thompson 2000). The assemblage of phytoliths recovered from these sherds was compared to wild rice chaff recovered from five Minnesota locations and five samples of northern flint corns. Two of the vessels are of the Malmo type, the earliest known ceramic ware at Mille Lacs. The other two are of the St Croix (see Figure 5) and Ogechie types. Together, these vessels represent the approximately 2000 years of human history (the Middle and Late Woodland periods) prior to European contact at Mille Lacs (Caine 1983; Thomas 2000). One of the Malmo vessels had a phytolith assemblage indicative of corn and is the earliest such secure documentation in Minnesota to date. The other three vessels, all contemporary with the corn vessel or younger, produced evidence of wild rice chaff (Thompson 2000). These findings attest to the enduring importance of wild rice in the human history of the Mille Lacs area.

The success of this research technique compliments other archaeological applications of phytolith analysis (e.g., Piperno 1988; Piperno and Pearsall 1993) and has demonstrated its utility in ceramic studies. One particularly important aspect of food residue analysis is the unambiguous cultural context of ceramic vessels. It is our opinion that analysis of food residues should be incorporated into any study concerning subsistence and/or pottery use. It should be remembered that flotation was once rarely practiced, but is now a standard research technique. In many soil types, plant macrofossils do not survive post-depositional processes, and food

Figure 5. The Fort Poualak Bowl, a St Croix pot used to cook wild rice at approximately A.D. 650 (Mather 2000; Thompson 2000). Photo Courtesy of the Lake Onamia/Trunk Highway 169 Data Recovery Project.

residues may provide the only sure cultural context for the recovery of data on plant use.

CONCLUSION

This paper has attempted to demonstrate that the study of wild rice holds clear benefits and unique challenges in the archaeology of the northern Midcontinent. Wild rice has always been an important natural resource. The human questions concern its past concentration and distribution, as well as the timing of technological innovations for curing and storage, and techniques for securing a predictable surplus. Archaeological indications of such processes are provided by the remains of ricing jigs, storage pits, parching areas, and other features, and often by the charred remains of the grain itself. Phytolith analysis offers a unique opportunity to study wild rice in a clear cultural context, as the remains of a meal in a single ceramic pot. It is expected and hoped that future innovations will continue to advance the archaeological study of this important food.

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PALEOETHNOBOTANICAL INVESTIGATIONS AT THE BIG RICE SITE: LAUREL CULTURE USE OF WILD RICE (*ZIZANIA AQUATICA* L.) AND ASSOCIATED RADIOCARBON DATES

Seppo H. Valppu

ABSTRACT

Advances in dating small amounts of charcoal by the Accelerator Mass Spectrometry (AMS) method has allowed accurate dating of individual wild rice kernels found in archaeological contexts. This paper deals with the analysis of samples collected from a wild rice processing site on Big Rice Lake, St Louis County, Minnesota. The results indicate that the beginnings of wild rice processing, use, and the first appearance of pottery in the area occur together in the Initial Woodland period (Laurel Culture) about 2000 years before the present.

INTRODUCTION

Food procurement has played an important role in cultural development. For the Initial Woodland Laurel Culture, which had its focus in Minnesota's Rainy River drainage (Dawson 1983; Peters 1988a), dependency on wild rice is thought to have played a key role in population expansion, ceramic technology, and subsequent building of burial mounds (Wilford 1955; Johnson 1969; Stoltman 1973; Lugenbeal 1976; Mason 1981; Dawson 1983; Rajnovich 1984; Lofstrom 1987). However, this paleoethnobotanical assumption has remained questionable because wild rice remains have not been found on any of the known Laurel sites (Stoltman 1973; Gibbon and Caine 1980; Rajnovich 1984).

Paleoethnobotany deals with plants that humans have utilized in the past, concentrating more on the identification of seeds and fruits than on other plant parts (Renfrew 1973). In addition, a knowledge of plant physiology and phyto-geography can be useful to a paleoethnobotanist. Spatial distribution, preference for habitats, competition, growth requirements, and reproductive responses to environmental constraints can facilitate the interpretation of archaeological information and provide a better understanding of site location (Ford 1978). Paleoethnobotany can help determine possible environmental changes as well as ecological and economic relationships between humans and plants. The discipline can interpret prehistoric life practices based on the presence or absence of botanical material (Ford 1978). Plant macrofossils, botanical structures larger than pollen grains or phytoliths, can be used to complement palynological and phytolith studies in environmental and cultural contexts (Minnis 1978).

The opportunity to do paleoethnobotanical macrofossil work on the question of Laurel use of wild rice was presented to the senior author in the summer of 1986 at the Big Rice Lake site (21SL168), St Louis County, Minnesota. The excavations of this multi-component site were undertaken from 1983 to 1986 by the Cultural Resource Management Program, Superior National Forest, USDA Forest Service (Peters and Motivans 1984). As the excavation progressed, it became evident that the site had components from Initial (Laurel) and Terminal Woodland (Blackduck, Selkirk, and Sandy Lake) in addition to the Historic period. A Paleoindian component also may have been present, but the excavated evidence was limited to two projectile points of Paleoindian origin.

Traditional wild rice processing involves digging pits, leaving their mark on the stratigraphy as recognizable features. Excavation exposed many features; the upper levels of many of them contained mixed ceramics, indicating mixed stratigraphy. Therefore, soil sampling for this study had to be from the portion of features surrounded by sterile glacial deposits, which indicated very little, if any, soil mixing at these deeper levels.

Thus, the context provided the opportunity for archaeological evidence to address the question of when wild rice gathering and processing began on the site. Because the available pollen data from northern Minnesota ricing lakes had long indicated a substantial rise in the amount grass (Gramineae) pollen more than 3000-2500 B.P. (McAndrews 1969; Huber et al. 1985; Yourd 1988), it seemed only a matter of time until the archaeological evidence affirmed the human exploitation of wild rice at an early date (prior to the Terminal Woodland). The possibility of other plant species being utilized and knowingly or unknowingly disseminated by human activities and/or preferences, so-called "camp followers" (Yarnell 1964), was also noted in this study.

SITE DESCRIPTION

Geography and Setting

Big Rice Lake is located approximately 20 kilometers north of Virginia, Minnesota (see Figure 1) in the Big Rice outwash plain of Sandy Township in St Louis County, Minnesota, at 92° 29'W longitude and 47° 42'N latitude. The rooting zone is composed of loamy sand and sands (0.3 m to 1.0 m). The substratum is sand, gravel, with well-drained, light-colored soils, having a pH of < 6.0 (University of Minnesota Agriculture Experiment Station 1971). Peat deposits on the northeast and southwest skirt the area. The Big Rice Lake site (21SL163) is located in the NE 1/4, NE 1/4 of section 9 and NW 1/4, NW 1/4 of section 10, T60N, R17W, in the Superior National Forest, Minnesota. The site is on a breezy peninsula on the north side of the lake, 1 to 2 m above the lake surface and just east of the public access boat landing. The lakeshore is a gravelly ice push berm. Water flows into Big Rice Lake from the east via Rice River, which originates from Little Rice Lake, approximately two kilometers east of Big Rice Lake. The outflow is from the west end of the lake where Rice River continues toward the west and eventually north to the Rainy River, Lake of the Woods, Lake Winnipeg, and finally to Hudson Bay. Big Rice Lake can also be reached from the Pike River (east of Little Rice Lake), which flows into Vermilion Lake to the north by a relatively short portage (approximately 5 km) (Peters and Motivans 1984). The Laurentian Divide, which separates the Hudson Bay drainage from the Great Lakes drainage, is less than 20 kilometers south of Big Rice Lake. About 37 kilometers southwest is the divide with the Mississippi River watershed. The close proximity of several major drainage systems allows access to the site from most areas of Minnesota.

The elevation of Big Rice Lake is 437.4 meters above sea level, and the archaeological units on the site are approximately two meters above the surface of the lake. The location for this site is ideal from the perspective of prevailing winds. The area is open and exposed to the winds from west and south, which facilitates the processing of rice and keeps insects to a minimum. This quite large (840 ha) and shallow lake (maximum depth ~1.40 m and median depth ~1.00 m) is extensively covered by aquatic vegetation. A large bog that extends along both sides of Rice River to Little Rice Lake covers the eastern part of the lake. The vegetation cover of the latter, mainly wild rice, is considerably more dense than Big Rice Lake, and the shores are almost an inaccessible floating bog.

Modern Vegetation on the Site

Approximately 120 plants were collected and pressed during the field season, mostly herbaceous annuals and some perennials. The site proper consists of approximately one hectare of level, rocky land, much of which is covered by grasses and some young balsam poplar *(Populus balsamifera)* approximately 20 to 25 years old, perhaps indicating that large groups of people did not use the area in that time span. Other woody species, such as hawthorn *(Crataegus* sp.), juneberries *(Amelanchier* sp.), willow *(Salix* sp.), quaking aspen *(Populus tremuloides)*, basswood *(Tilia americana)*, and black ash *(Fraxinus nigra)*, are present. The periphery of the activity area has young mountain maple *(Acer spicatum)* and chokecherries *(Prunus virginiana)*. Bushes of currants and gooseberries *(Ribes* spp.), sweet gale *(Myrica gale)*,

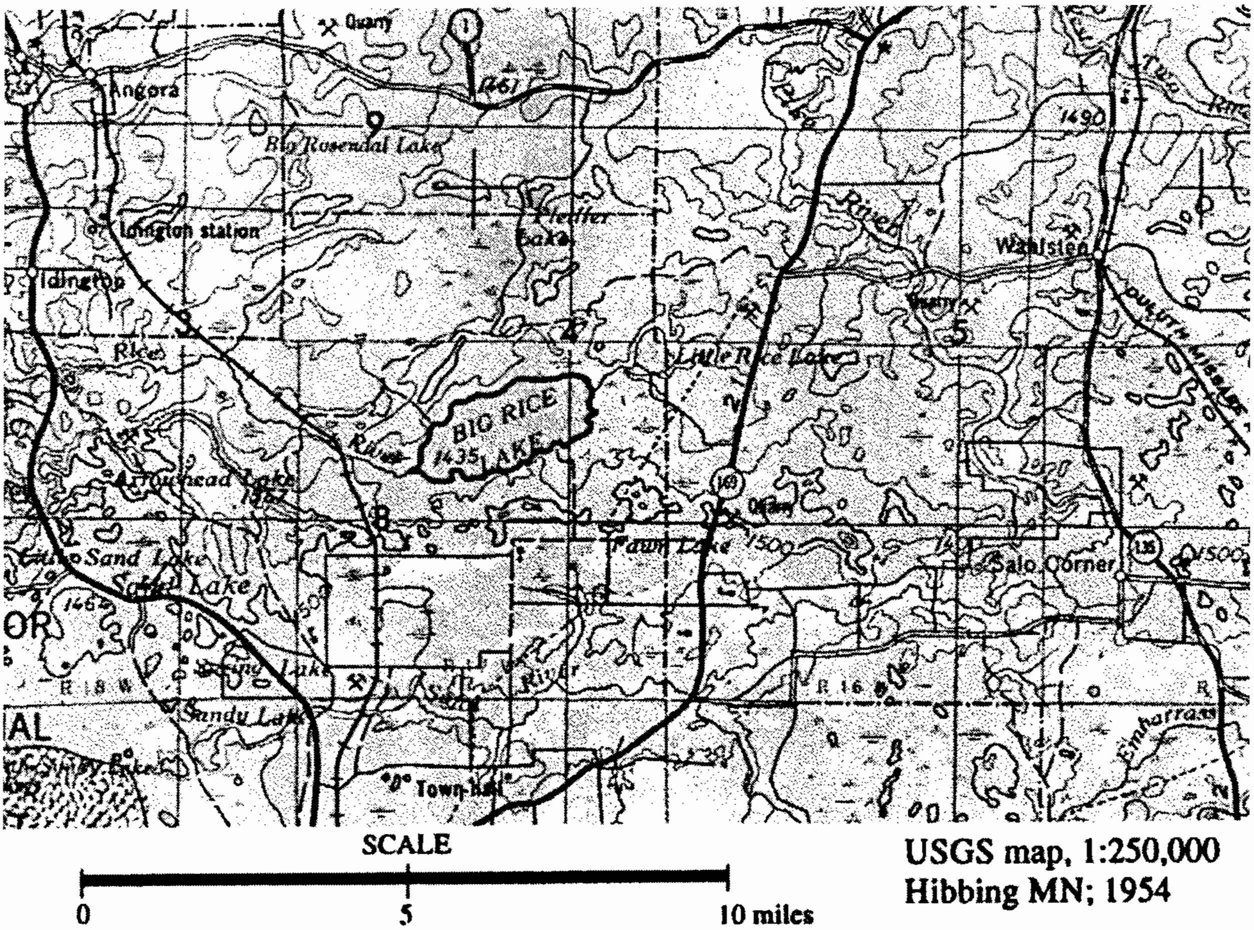

Figure 1. Big Rice Lake and the vicinity.

along with some herbaceous plants such as evening primrose *(Oenothera biennis)*, wild iris *(Iris versicolor)*, and sensitive fern (*Onoclea sensibilis)* dot the shoreline. About a half kilometer to the north of the site is a stand of sugar maple *(Acer saccharum)*, which shows signs of syrup tapping. The east and west sides of the site are surrounded by a low marshy area of sedges and grasses, black ash *(Fraxinus nigra)*, some poplars *(Populus* spp.), a few spruces *(Picea* spp.), balsam fir *(Abies balsamea)*, and tamarack *(Larix laricina)*.

Big Rice Lake is extensively covered by wild rice *(Zizania aquatica* cf. *Z palustris)* and occasional large areas of pickerel weed *(Pontederia cordata)*, bulrushes *(Scirpus* spp.), and arrowhead *(Sagittaria latifolia)*.

THE CULTURAL SEQUENCE

Initial Woodland Culture

In the Woodland periods, the mode of subsistence became more focal, and stands of wild rice became more established (McAndrews 1969; Huber et al. 1985; Yourd 1988). In northeastern Minnesota, the Initial Woodland cultural period marks the division between preceramic and ceramic technologies. It coincides with the Middle Woodland Cultures of the more southern parts of North America (Jelks 1988). The Laurel Culture, 2200 B.P. to 1250 B.P., was the first in the north to adopt ceramic technology. The Laurel name was adopted by professor L. A. Wilford from Laurel Township, Koochiching County, Minnesota, where some earlier excavations took place. The appearance of conical ceramic vessels manufactured by the coiling method and burial mounds characterize and distinguish Laurel. Both might indicate an increase in population, which could be a direct consequence of wild rice use (Dawson 1983; Rajnovich 1984). A trend to a more sedentary lifeway is perhaps reflected in burial mound construction.

The Laurel Culture extended from northern Michigan through northwestern Ontario, northern Minnesota, and south-central Manitoba, to east-central Saskatchewan (Janzen 1968; Dawson 1983; Peters 1988a). In Minnesota, the Laurel focus was in the Rainy River flowage. The type site is the Smith Mound, also known as Grand Mound or Laurel, located on the southern bank of the Rainy River (Anfinson 1979). The Laurel pottery is characterized by excellent quality, grit temper, conical bottoms, and a smooth finish except in the neck and rim areas, which were decorated by stamping, punctating, incising, and bossing. The Laurel artifacts included togglehead antler harpoons, beaver incisors, copper tools such as fish hooks, drills, fishing spears, and copper beads (Peters 1988a).

Terminal Woodland Culture

Terminal Woodland, 1200 B.P. to 400 B.P., is parallel to the Late Woodland Culture farther south. The earliest Terminal Woodland Culture is the Blackduck, a name adopted from L. A. Wilford's excavations near Blackduck, Minnesota, in the early 1940s (Wilford 1941, 1955; Peters 1988b). Blackduck ceramics are the principal diagnostic trait; vessels are globular and round-bottomed with thick, flaring decorated rims and lips. The bodies were decorated by bag/fabric impressions or cord-wrapped paddle; the rims and the necks were treated with cord-wrapped stick and often indented on the exterior, thus producing bossing in the interior. The rim sherds characteristically show combinations of impressions and indentations; the lip has the same impressions. Other cultural traits include burial mounds, copper fish hooks, copper beads, barbed bone harpoons, small triangular projectile points with notched sides, bone spatulas, and oval and lunate knives (Wilford 1941; Peters 1988b). Later Terminal Woodland Cultures found on the Big Rice Site include Selkirk and Sandy Lake. The characteristic pottery of these cultures was manufactured by fabric basket or paddle and anvil methods. They have straight rims, rounded bases and fabric-marked exteriors, with only the upper third of the pot decorated by punctation and cord-wrapped stick impressions (Dawson 1983).

THE EXCAVATION

Approximately 35 square meters of historic and prehistoric wild rice processing areas were excavated. (See Figure 2.) Excavation occurred in five areas; each was taken down to 40 cm, at which depth sterile sediment was encountered. Area A, with a 4 x 5 m excavation area, was the most extensive. (See Figure 3.) Area B consisted of a 2 x 3 m block that also extended to the depth of 40 cm. (See Figure 4.) Area C was 2 x 2 m square to the west of Area A and did not produce as many artifacts. Area D was opened in the summer of 1986 and consisted of a 1 x 4 m trench with a final depth of 40 cm. One unit was excavated in 1983, but terminated when a large rock was encountered.

The glacial deposits at 40 or more cm are composed of sand and silty sand. The upper layers especially in the activity area contain schistose rocks, some of which are quite large and often fire-cracked. Area A can be considered the main area of activity because most of the recovered artifacts came from this area and were mostly pottery sherds (> 40,000) of Initial and Terminal Woodland Cultures. Other finds included native copper artifacts, such as pressure flakers, awls, and one togglehead harpoon; large and small scrapers made of Knife River Flint, Hudson Bay Lowland Chert, Gunflint Silica and other materials, and some obsidian flakes. A few projectile points were Initial Woodland types, but most were the triangular type of the Terminal Woodland. One fractured catlinite platform pipe was recovered from Area A. Animal bones were quite common throughout the excavation units, including beaver, whitetail deer, fish, and various waterfowl species, suggesting use and giving a good inclination of the time frame for the seasonal site occupation.

METHODS AND PROCEDURES

Samples from Features

Samples for paleoethnobotanical analysis were taken from features. All of the representative samples were excavated from areas adjacent to the sterile glacial sediments, and, in each case, the whole feature was extracted with trowels down to the till. The depth was 36 to 39 cm (3 cm arbitrary excavation levels were used throughout the excavation). Features were identified as darkened soil within the lighter subsoil. It was assumed that these stained areas represented fire hearth bottoms and rice processing pits. A decision to process the soils in the laboratory rather than on the site was made to avoid any potential contamination.

In Area A (see Figure 3), all 37 features on excavation levels 12 and 13 were extracted completely. Features 25 and 26 were exceptional in being cone-shaped, clay-lined fire pits, or jigging pits. None of the other features were constructed in a similar manner. This type of construction was discovered previously in the Mille Lacs Lake area (Johnson 1969) in connection with wild rice processing.

Feature 1 in Area B (see Figure 4) was sampled for plant macrofossil analysis because it contained Laurel pottery. Although some other features in Area B included diagnostic Laurel sherds, they also contained Terminal Woodland sherds. Feature 1 was removed in three separate levels: 27 to 30 cm below the surface (level 10); 30 to 32 cm (level 11); and 32 to more than 40 cm (levels 12, 13, and 14). For analysis, only 1.4 liters at the bottom of the feature (levels 13 and 14) were examined for seed content. The upper levels were not analyzed because Feature 3, which bottomed out at 35 cm, was in close proximity to Feature 1 and contained mixed Initial and Terminal Woodland ceramics.

Flotation and Processing

Extraction of the macrobotanical remains was carried out by flotation using a series of U. S. Standard Testing Sieves: 6.3 mm; 2.8 mm; 1.18 mm; and 0.09 mm. Flotation is perhaps the most widely used method to recover botanical material, and many variations exist (Struever 1968; Limp 1974; Lange and Carty 1975; Keeley 1978; Diamant 1979; Schaaf 1981). Flotation is based on seeds, charcoal, and other botanical materials separating from heavier material by floating to the top. They can then be screened for further analysis.

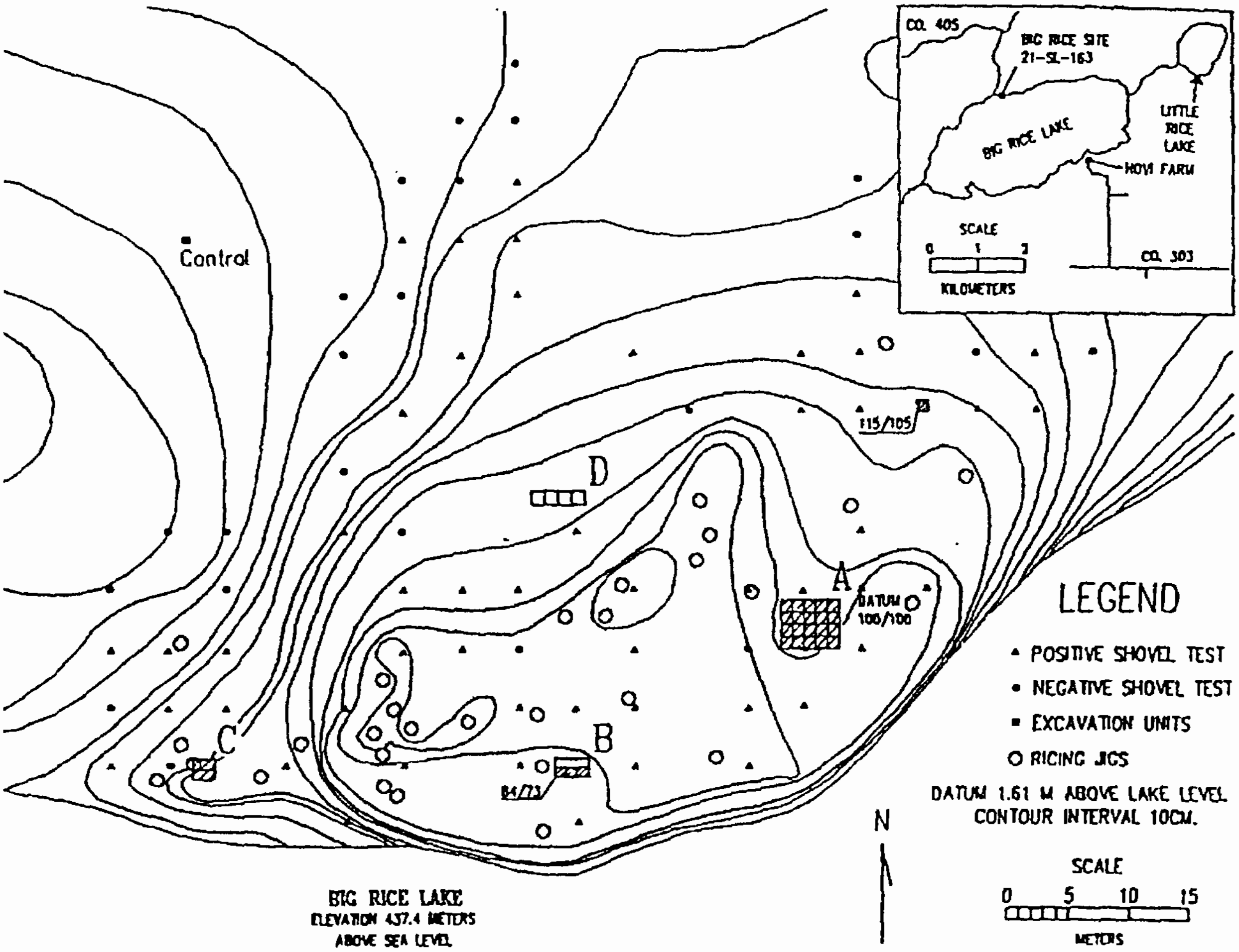

Figure 2. Plainview of the Big Rice Site (21SL163).

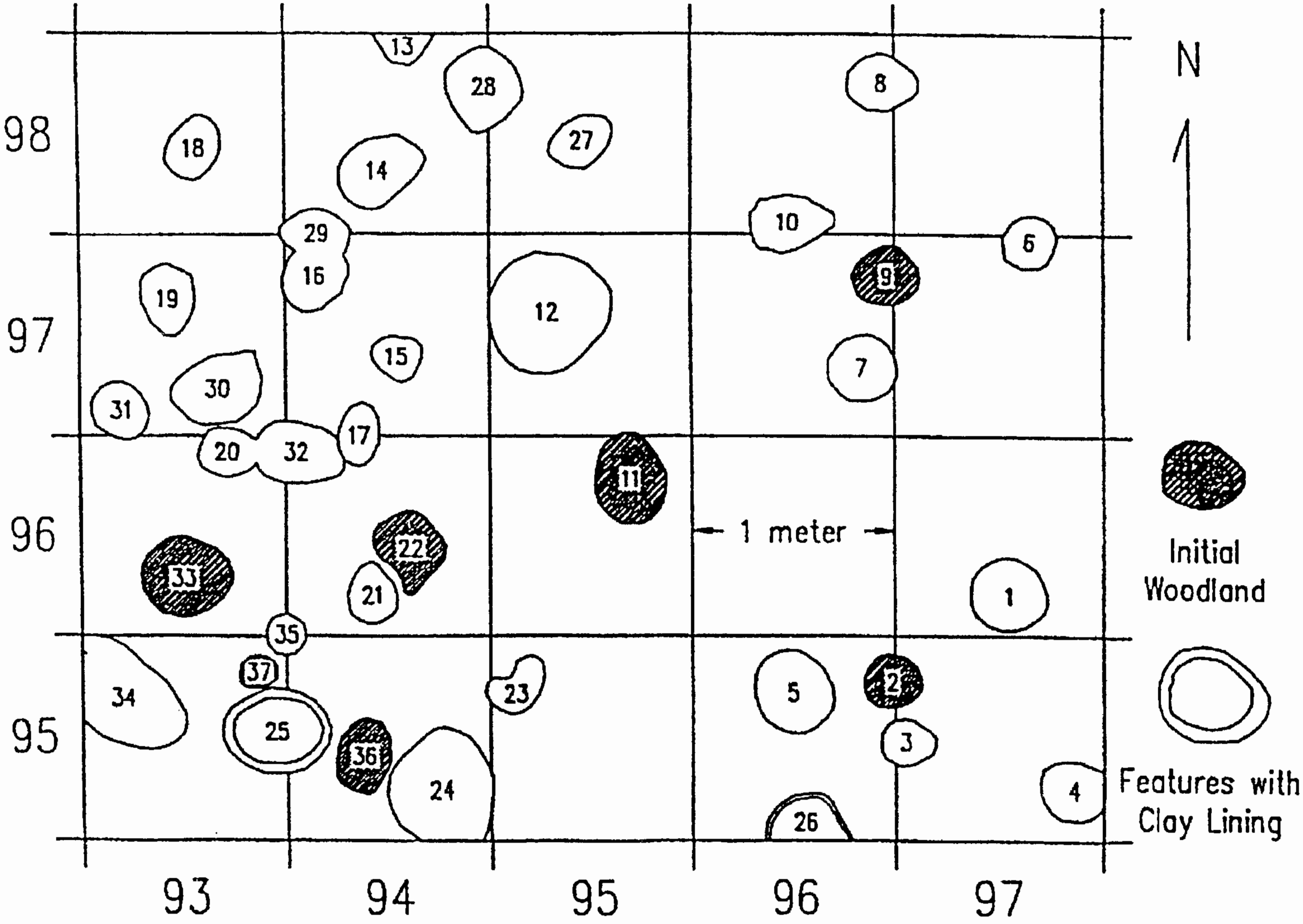

Figure 3. Big Rice Site (21SL163), Area A features.

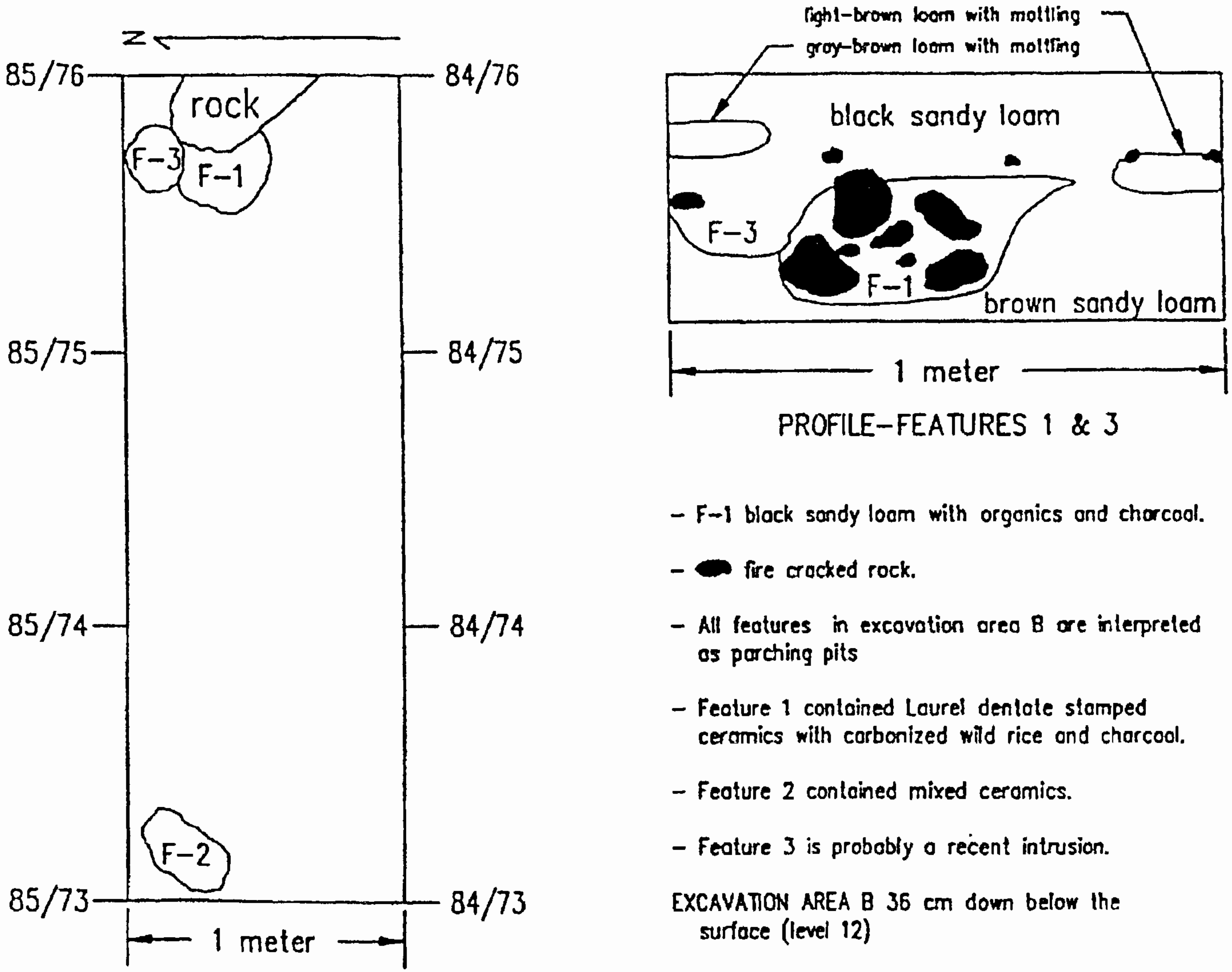

Figure 4. Big Rice Site (21SL163), Area B features.

Table 1. Seed totals from Area A.

Species	Total Number	Total Percent
Galium cf. aparine	390	26.4
Zizania aquatica	305	20.6
Chenopodium sp.	299	20.2
Polygonum sp.	115	7.8
Unknowns	68	4.6
Abies balsamea (needles)	60	4.1
Rubus idaeus-type	42	2.8
Gramineae (undiff.)	42	2.8
Prunus virginiana	37	2.5
Sambucus pubens	32	2.2
Diervilla lonicera	31	2.1
Scirpus sp.	29	2.0
Solanum dulcamara	16	1.1
Amelanchier sp.	4	*0.3*
Picea sp. (needles)	4	0.3
Prunus americana	3	0.2
TOTAL	**1477**	**100.0**

By repetition, total recovery of the light fraction can be achieved. After screening, the recovered material was air-dried and bagged.

Sample sizes varied from small (0.4 liters), in which case the whole sample was processed, to large (27.6 liters), in which case the quantity was reduced to 5 liters using a riffle-box splitter. The five-liter samples were processed in plastic buckets in two equal portions.

The recovered and sorted material was identified using a stereo dissecting microscope with magnifications ranging from 10.5X to 45X. The major portion of the microscope work was conducted using the lowest magnifications. All seeds and other diagnostically important and identifiable botanical material, such as conifer needles, were separated by using a small brush or needlenose tweezers. Modern seed reference collections and seed identification manuals were utilized for the identifications (Martin and Barkley 1961; Montgomery 1977). The abundance of each species was tabulated using total number of fragments from each feature. (See Table 1.)

Table 2. AMS radiocarbon dates of *Zizania aquatica* seeds from Area A.

Feature	Sample	Conventional ^{14}C Age (B.P.)	1 σ Max Cal Age (intercepts) Min Cal Age	2 σ Max Cal Age (intercepts) Min Cal Age
11	(BA 94091)	1910 ± 100	B.C. 35 (A.D.81) A.D. 229	B.C. 156 (A.D. 81) A.D. 339
22	(BA 94092)	2040 ± 100	B.C. 172 (44, 5, 5) A.D. 66	B.C. 358 (44, 5, 5) A.D. 133
33	(BA 94093)	2020 ± 90	B.C. 160 (39, 29, 22, 10, 1) A.D. 72	B.C. 349 (39, 29, 22, 10, 1) A.D. 133
36	(BA 94094)	1060 ± 80	A.D. 894 (989) 1024	A.D. 780 (989) 1159
36	(Beta-75859)	600 ± 60	A.D. 1299 (1327, 1346, 1393) 1410	A.D. 1283 (1327, 1346, 1393) 1435

ANALYTICAL RESULTS

Table 1 demonstrates the species diversity found in the features, presents the total numbers of seeds and other identifiable material, and lists total percentages of each species. A significant reduction in abundance is obvious after the first three species.

Radiocarbon Dates

Five AMS radiocarbon dates were obtained from Area A. (See Table 2.) The calibrations/corrections were done using University of Washington, Quaternary Isotope Lab, CALIB 4.2 (Stuiver et al 1998). Four of the samples were analyzed at Peking University, Beijing, China, and one at Beta Analytic, Inc., Florida. All AMS dates were obtained in 1994.

Radiometric dating of one charcoal sample was done at the University of Pittsburgh in 1988. This sample (PITT-0349) was from Area B, Feature 1, and produced a date of 1670 + 45 B.P.

CONCLUSIONS

Archaeological evidence advances the possibility that the site was occupied at least intermittently from the Initial Woodland times to the later 1930s. The site was utilized seasonally for wild rice gathering where sufficient stands of rice occurred in the lake. In general, the spread of wild rice and its use in the area mark the division between the preceramic and ceramic; perhaps rice processing initiated the need for ceramic technology or conversely, ceramic technology made processing efficient. Wild rice use among prehistoric peoples is known. Ford and Brose (1975) report an archaeological find in Michigan of 33 charred grains of wild rice in association with a Late Archaic or Early Woodland feature. Dating for the find, based on the associated artifacts, is approximated to be 2350 to 2550 B.P.

In Minnesota and the western Great Lakes area, the earliest prehistoric use of this aquatic grass was attributed previously to the Terminal Woodland Cultures (Blackduck, Selkirk, and Sandy Lake) (Johnson 1969; Gibbon and Caine 1980; Rajnovich 1984). Although many assumptions about Laurel use of wild rice have been made prior to excavation of the Big Rice site, no previous radiocarbon dating of *Zizania aquatica* seeds from any Laurel archaeological feature had been undertaken. McAndrews (1969), on the basis of Gramineae pollen, believes the onset of wild rice use coincided with the beginning of mound building in the Rainy

River area. Rajnovich (1984) suggests that wild rice was harvested in the Lake of the Woods area as early as 2200 B.P. However, evidence for this is circumstantial and based on the settlement patterns of the sites in association with modern rice stands. Outside of the Big Rice site, direct archaeological evidence for wild rice use during the Initial Woodland period in Minnesota is non-existent, and no archaeological evidence of wild rice presence exists in the Archaic archaeological context in Minnesota. Additional plant species suspected to have been used were chenopods *(Chenopodium* sp.) and bedstraw *(Galium* sp.). All species are "camp-followers," successfully habiting disturbed soils around human occupation areas and also used by humans for food and technology (Yarnell 1964).

The numerous pottery sherds and pits from the Big Rice site strongly suggest wild rice processing. This is supported by the abundant rice seeds found in the features. All of the features with only Laurel ceramics contained wild rice, and the radiocarbon dates on rice kernels generally support an age of 2000 B.P. for the onset of use at this site. Given the associations of *Zizania aquatica* with the Laurel ceramics and the available radiocarbon dates, it is certain that Laurel people used wild rice on this site.

As seen in the two radiocarbon dates from Area A, Feature 36, the stratigraphy in the rice processing area may be mixed. The dates indicate a Terminal Woodland occupation, which correlates well with the Blackduck rims in this feature. (See Table 2.) However, the same feature also contains smooth body sherds, which suggests Laurel. The AMS dates from Features 11, 22, and 33 all support an Initial Woodland use of wild rice.

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ARCHAEOLOGICAL IMPLICATIONS OF POLLEN EVIDENCE FOR WILD RICE (*ZIZANIA AQUATICA*) DURING THE PALEOINDIAN, ARCHAIC, AND WOODLAND PERIODS IN NORTHEAST MINNESOTA

James K. Huber

ABSTRACT

Wild rice (*Zizania aquatica*) is associated with several Woodland archaeological sites in northeast Minnesota beginning about 2500 years ago. Ethnographic accounts indicate that wild rice has been utilized by Native Americans for subsistence for many centuries and it is believed that wild rice was a major part of Native American subsistence throughout the Woodland Period. Wild rice grains have been found in association with a Woodland Laurel feature dated at 1670 ± 45 years before the present (B.P.) at the Big Rice site, northeast Minnesota. Based on palynological evidence, Big Rice and several other lakes in Minnesota indicate the presence of wild rice during the Woodland Period. However, there is a limited amount of palynological data available that indicates that wild rice was present in harvestable quantities for a considerable period of time before it was utilized as a major food source. The earliest record of wild rice macrofossils are from Wolf Creek in east central Minnesota dating between 9000 and 10,000 years B.P. during the Paleoindian Period. At least six lakes in Minnesota indicate that wild rice was available during the Archaic Period. Although the harvesting of wild rice is usually associated with the advent of ceramics, limited palynological data implies that wild rice was probably present in quantities large enough to provide a substantial food source during the Paleoindian and Archaic periods.

INTRODUCTION

Ethnographic accounts (Berde 1980; Carlson 1934; Densmore 1928; Jenks 1900) indicate that wild rice (*Zizania aquatica*) has been utilized by Native Americans for subsistence for many centuries. Dickinson's (1968) annotated bibliography suggests the importance of wild rice as food and provides many useful references on this subject. Evidence for the utilization of wild rice has also been found in archaeological sites (Valppu 1989; Peters and Motivans 1984; Johnson 1969a; Johnson 1969b). Johnson (1969a; 1969b) found direct evidence for the prehistoric use of wild rice in the form of charred rice grains and ricing jigs at Nett Lake, Lower Rice Lake, and Petega Point, Minnesota. The jigs were used to remove the husk from the rice grains. This was accomplished by people moving their feet over the parched rice (Johnson 1969a).

Wild rice is a grass (Gramineae), and its pollen is a monoporate grain, approximately 34 μm in diameter. (See Figure 1.) Wild rice pollen is similar in size and surface sculpturing to most other grass pollen and cannot be identified to the species with absolute certainty. The presence of wild rice in the pollen record is based primarily on abundance. Based on modern and fossil pollen deposition, a pollen percentage value of 40% of the pollen sum indicates the presence of a major stand of wild rice in a lake (Yourd 1988).

VEGETATIONAL HISTORY

In order to assess the presence of wild rice in the pollen record recovered from lake sediments, the vegetational history of the area must be understood. In northeast Minnesota, a tundra environment was established in deglaciated areas by 14,700 years before the present (B.P.). Tundra was being replaced by a shrub parkland in the southern part of the region by about 12,000 years B.P. Shrub parkland migrated into the study area approximately 10,500 years B.P. By 8300 years B.P., the Arrowhead Region was covered by a conifer or conifer-hardwood forest. As succession and plant migration continued, the forest became a mixed conifer-hardwood forest dominated by jack and/or

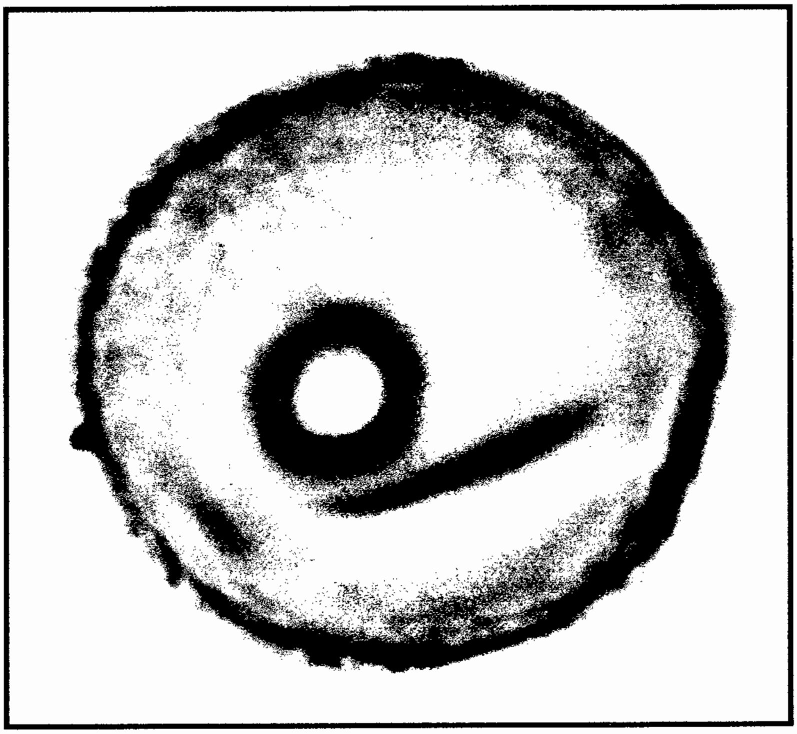


Figure 1. Wild rice pollen grain approximately 34 μm in diameter.

red pine. Jack and/or red pine were replaced approximately 7000 years ago by white pine as it migrated into the Arrowhead Region. Forest patterns changed as arboreal taxa dominance shifted about 3000 years ago when spruce became more abundant. An increase in *Ambrosia*-type (ragweed) pollen occurred about 1890 with the advent of Euro-American settlement and logging (Maher 1977; Huber 1992; Huber and Seifert 1994).

East Bearskin Lake (see Figure 2) provides a good example of a pollen sequence from a non-wild rice lake in northeast Minnesota (see Figure 3). The pollen diagram from East Bearskin Lake shows a typical grass (Gramineae) pollen profile. (See Figure 3.) Gramineae percentage values occur at less than 10% throughout the profile.

BIG RICE LAKE

Peters and Motivans (1984) reported the presence of a large rice processing site (Big Rice Site 21 SL 163) on the north shore of Big Rice Lake near Virginia, Minnesota. (See Figure 2.) Thirty-one ricing jigs and several grains of wild rice were found at the site. Pottery associated with the site includes more than 50,000 sherds of Laurel, Blackduck, Sandy Lake, and Selkirk ceramics. This suggests that the pottery was instrumental in the processing of wild rice (Peters and Motivans 1984). In a study of flotation samples from the Big Rice site, Valppu (1989) identified wild rice seeds from several of the samples as well as other floral material. The wild rice grains are associated with Laurel ceramics and ricing jigs (Valppu 1989). Based on a date from a Laurel feature, this association occurred at 1670 ± 45 years B.P. (Rapp et al. 1990).

In the Big Rice Lake pollen diagram (see Figure 4), Zone 6 is characterized by a dramatic increase in Gramineae pollen. Gramineae pollen increases abruptly from 5% at the top of Zone 5 to 46% at the bottom of Zone 6. The increase in Gramineae is attributed to an expansion of wild rice in the lake. There is no date on the increase in Gramineae from the core. However, the major increase in the Gramineae pollen profile is estimated to date between 3000 and 2000 years ago based on sediment accumulation rates.

Wild rice was probably present in Big Rice Lake prior to the major increase in Gramineae pollen. *Zizania aquatica* grows best in approximately 2 m of water or less (Vennum 1988). Big Rice Lake is a large flat-bottomed lake, and, as sediment infilled the lake to reduce the water level, wild rice was able to expand very quickly over most of the lake. At the time of coring, the water depth at the coring location was 1 m. Currently, the water depth over most of Big Rice Lake is approximately 1 to 1.3 m. The increase in the Gramineae pollen profile starts at 55 cm below the water/sediment interface at the time of coring. Based on this information, the approximate depth of Big Rice Lake at the time Gramineae rise began was between approximately 1.5 and 1.8 m.

GEGOKA LAKE

As part of a multidisciplinary investigation of the Misiano archaeological site, pollen and nonsiliceous algae were recovered from a 262 cm core from Gegoka Lake, Lake County, Minnesota. Gegoka Lake has a small watershed, is a headwater lake, and currently supports a large stand of wild rice. (See Figure 2.)

In the Gegoka Lake pollen diagram (see Figure 5), a small increase in Gramineae occurs in Zone 6. Gramineae values increase from 2.2% at the top of Zone GL-5 to 5.2% at the beginning of Zone GL-6 and falling to 3.6% at the top of the core. *Ambrosia*-type percentages increase slightly from the previous zone. Gramineae concentration is greater than in any of the previous zones, ranging from 3775 grains/cm^3 to 21,575 grains/cm^3. *Ambrosia*-type concentration is 1290 grains/cm^3 at the top of GL-5, increases to 9240 grains/cm^3 at the bottom of GL 6, then declines to 3340 grains/cm^3 at the top.

The increase in Gramineae pollen is attributed to the expansion of wild rice, which is currently growing over much of Gegoka Lake. The increase in Gramineae abundance is lower than that found at other rice lakes and may indicate that the expansion

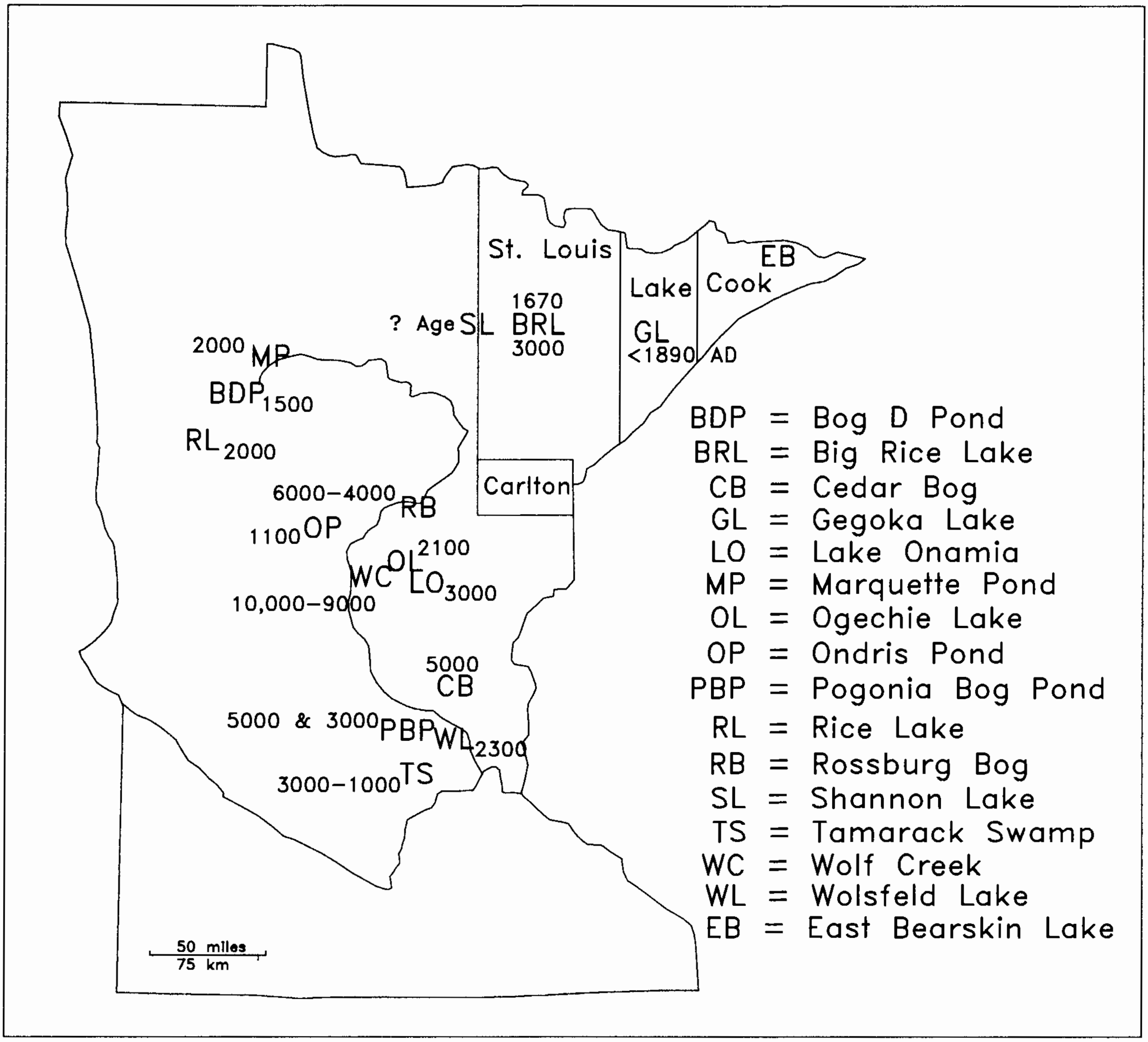
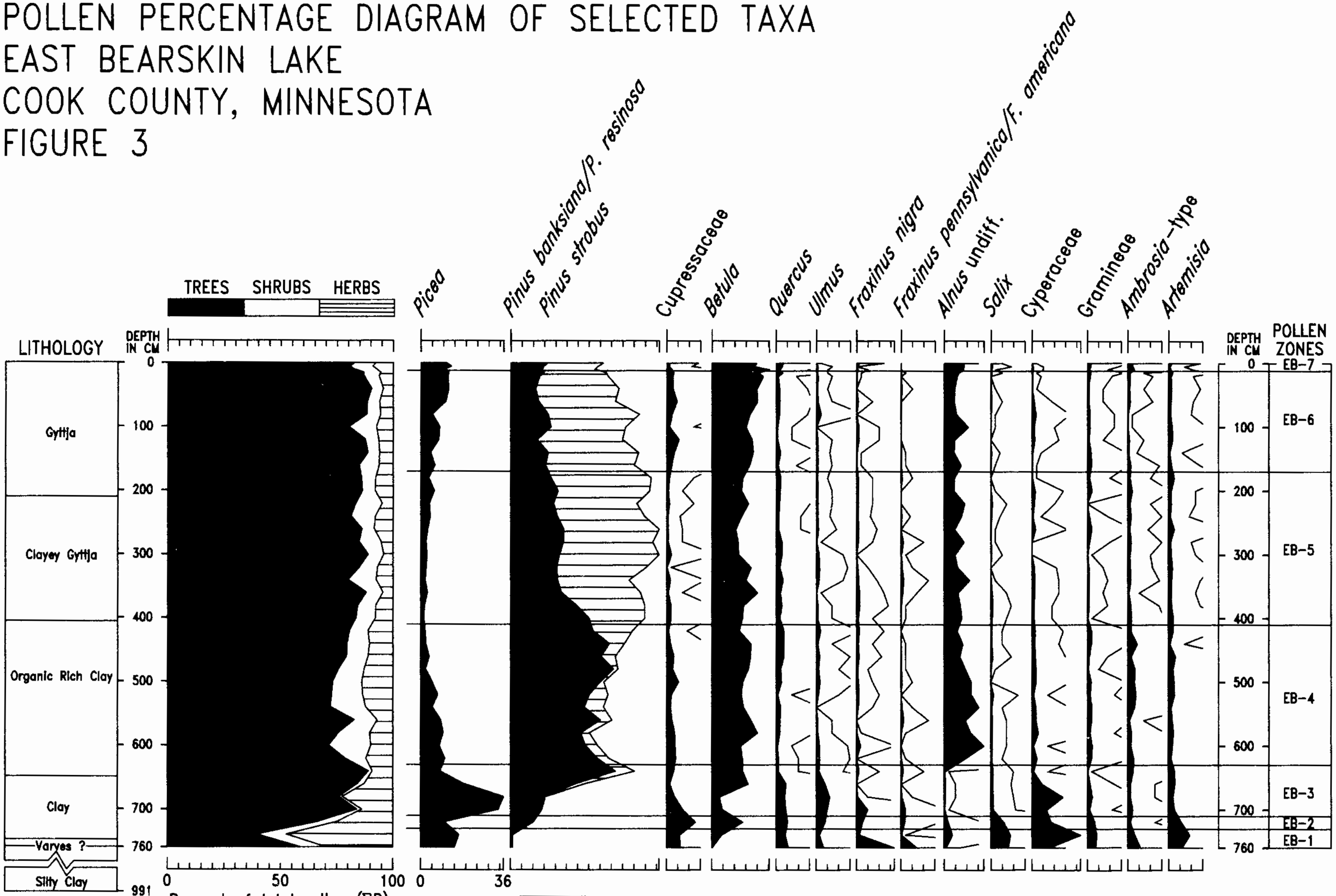


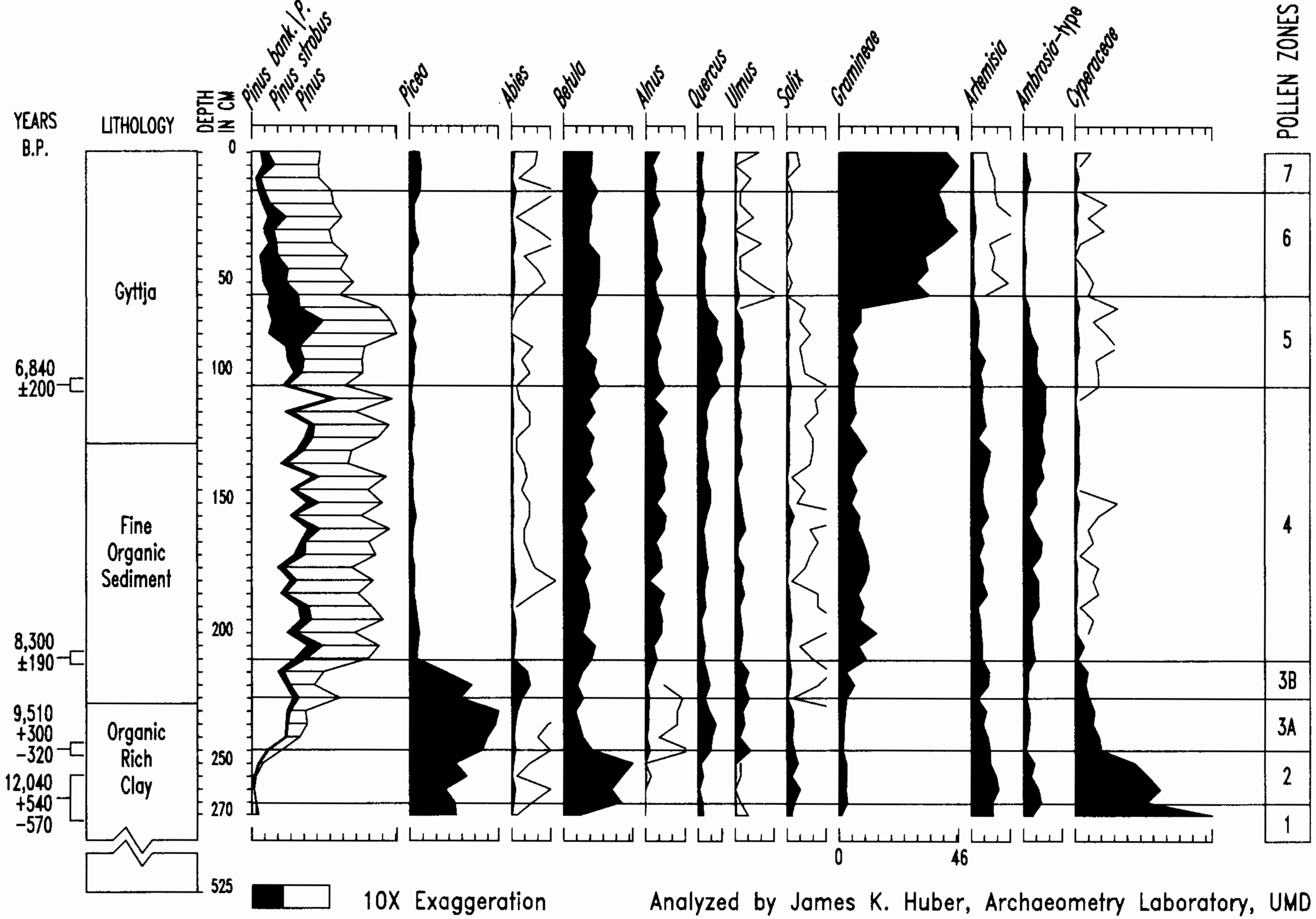
Figure 2. Location map of East Bearskin Lake and Gramineae rise pollen sites in Minnesota. Date of Gramineae rise is in yr B.P. unless noted.

POLLEN PERCENTAGE DIAGRAM OF SELECTED TAXA
EAST BEARSKIN LAKE
COOK COUNTY, MINNESOTA
FIGURE 3

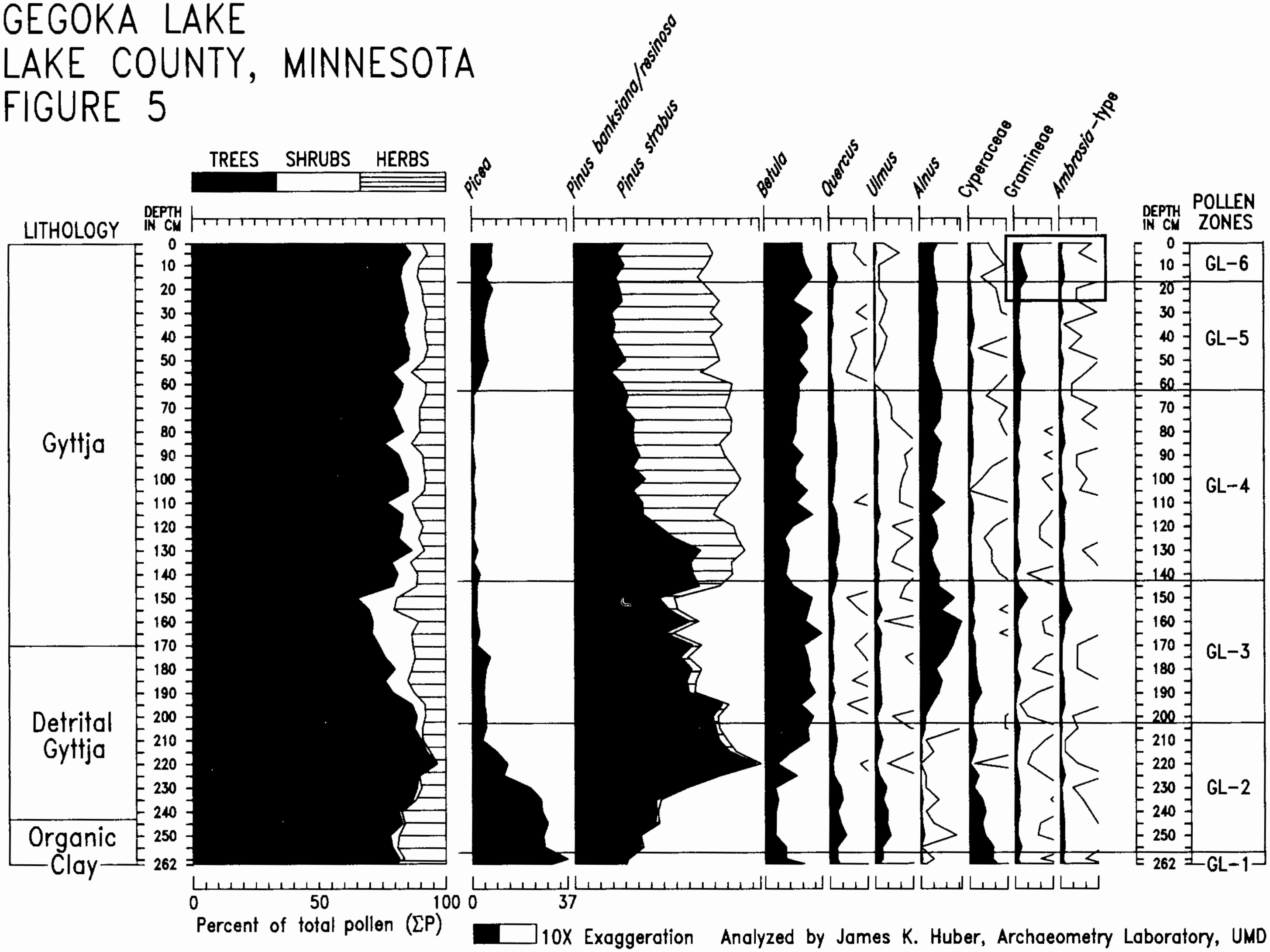


Analyzed by James K. Huber, Archaeometry Laboratory, UMD

POLLEN PERCENTAGE DIAGRAM OF SELECTED TAXA
BIG RICE LAKE
ST. LOUIS COUNTY, MINNESOTA
FIGURE 4



POLLEN PERCENTAGE DIAGRAM OF SELECTED TAXA
GEGOKA LAKE
LAKE COUNTY, MINNESOTA
FIGURE 5



of wild rice in Gegoka Lake is a relatively recent event. The *Zizania aquatica* population may have expanded during GL-6 as infilling of the lake created more favorable habitat. The small increase in *Ambrosia*-type pollen concentration in GL-6 may indicate the advent of Euro-American settlement and deforestation in the area. Euro-American settlement occurred about 1890 in this part of Minnesota (Maher 1977). If the small *Ambrosia*-type pollen rise is associated with the advent of Euro-American settlement, it is very probable that the presence of wild rice in Gegoka Lake is the result of planting by the Civilian Conservation Corps (CCC). The CCC tried to establish wild rice in many lakes in northeast Minnesota in the 1930s.

SHANNON LAKE

Shannon Lake is located approximately 40 km west northwest of Virginia, Minnesota. (See Figure 2.) The 55-ha lake has a maximum depth of less than 6 m. Approximately 10 ha of the lake contains wild rice beds.

A prehistoric archaeological site is located on Shannon Lake. During a preliminary survey of this site, lithic materials, pot sherds, and a ricing jig were found. However, nothing diagnostic to specifically date the site was recovered. The pot sherds recovered indicate that the site is of the Woodland Period (Gordon Peters, Superior National Forest, personal communication, 1987).

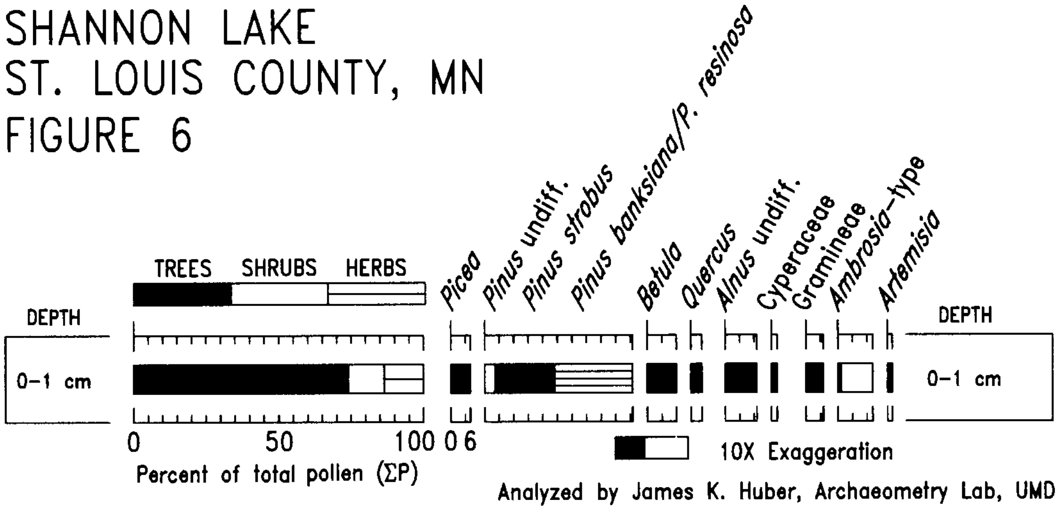
Pollen has been counted for the uppermost sample of an 8-m core recovered from the central portion of Shannon Lake. Gramineae pollen only accounts for 6% of the pollen recovered. (See Figure 6.) Marquette Pond, a 13-ha lake in Beltrami County, Minnesota, also contains approximately 10 ha of wild rice beds (Yourd 1988). The Gramineae value in the uppermost pollen sample from Marquette Pond is approximately 45% (Yourd 1988). Although the beds of wild rice in Shannon Lake are approximately equal in size to those of Marquette Pond, the Shannon Lake wild rice beds only make up one-fifth of the area of the lake. The low value of Gramineae pollen in Shannon Lake indicates that local influx of wild rice pollen is being dampened by regional pollen influx. The dampening effect appears to be caused by the low wild rice stand to lake basin ratio. The Gramineae pollen data from Shannon Lake suggest that substantial beds of wild rice occurring in bays and shallows of large lakes in the past may not be reflected in the pollen record.

OTHER WILD RICE LAKES

McAndrews (1969) did a palynological investigation of a core from Rice Lake, Becker County, Minnesota. (See Figure 7.) This lake is associated with the Mitchel Dam archaeological site (McAndrews 1969). His investigation suggests that wild rice was present over most of the lake approximately 2000 years ago. At Rice Lake, Ontario, near the McIntyre site, McAndrews (1984) has shown that wild rice was probably present in harvestable quantities 3700 years ago during Late Archaic occupation of the site.

The earliest record of wild rice macrofossils are from Wolf Creek (see Figure 7) in east central Minnesota (Birks 1976). Based on palynological data, a Gramineae rise has been attributed to the expansion of *Zizania aquatica* at Bog D Pond (McAndrews 1966), Cedar Bog Lake (Cushing 1963), Lake Onamia (McAndrews unpublished in Yourd 1988), Marquett Pond (Yourd 1988), Ogechie Lake (McAndrews unpublished in Yourd 1988), Ondris Pond (Jacobson 1975; Jacobson 1979), Pogonia Bog Pond (Swain 1978), Rossburg Bog (Wright and Watts 1969), Tamarack Swamp (Swain 1978), and Wolsfeld Lake (Grimm 1981). The oldest Gramineae rise is at Wolf Creek which dates between 9000 and 10,000 years B.P. (Birks 1976). At Rossburg Bog, the Gramineae rise occurs between 4000 and 6000 years B.P. (Wright and Watts 1969). The Gramineae rise begins about 5000 years ago at Cedar Bog Lake (Cushing 1963), about 2300 years ago at Wolsfeld Lake (Grimm 1981), approximately 1500 years ago at Bog D Pond (McAndrews 1966), and around 1100 years ago at Ondris Pond (Jacobson 1975; Jacobson 1979). Figure 2 shows the location of pollen sites in Minnesota with a Gramineae rise attributed to the

POLLEN PERCENTAGE DIAGRAM OF SELECTED TAXA
SHANNON LAKE
ST. LOUIS COUNTY, MN
FIGURE 6



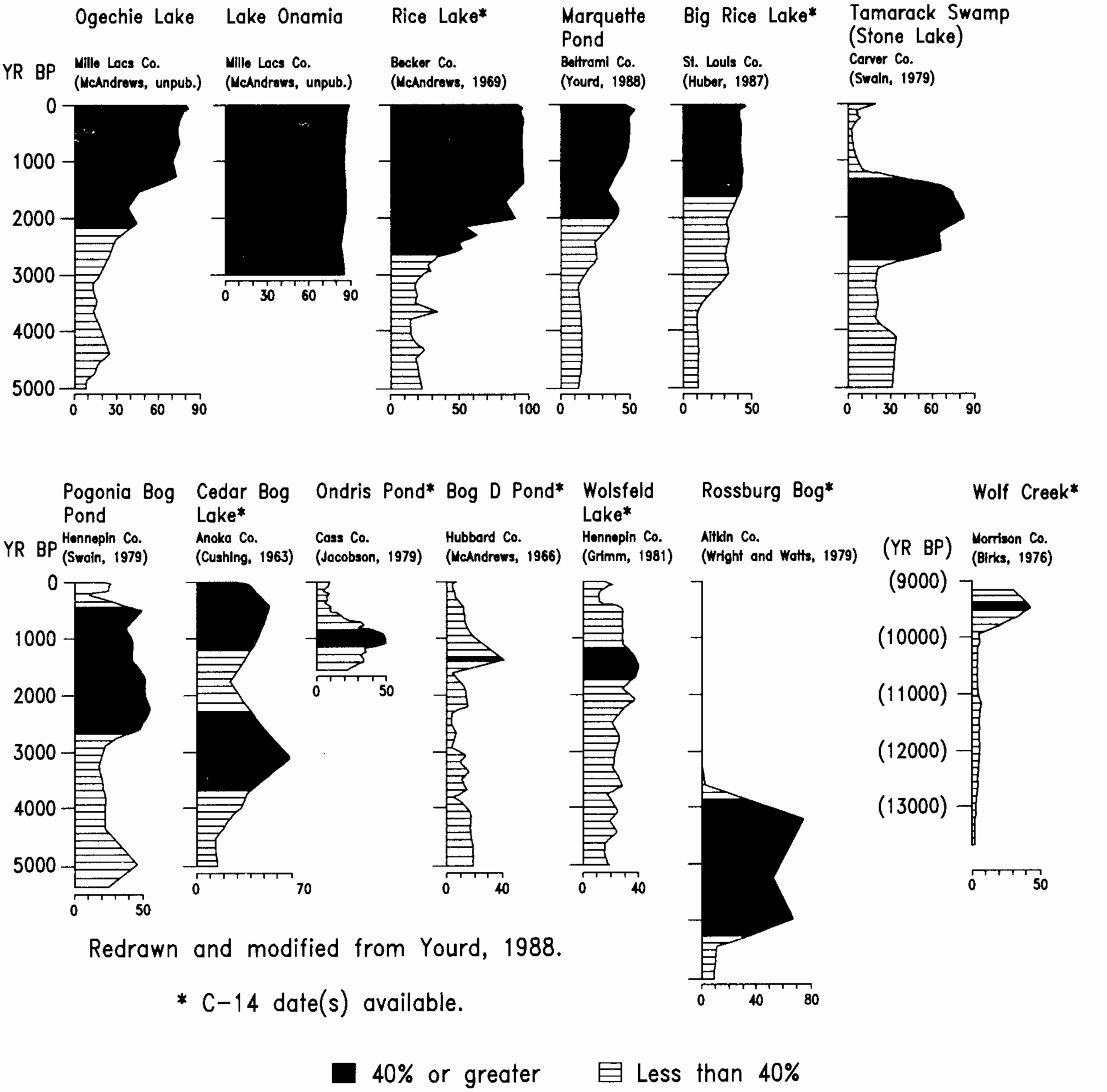


Figure 7. Gramineae pollen profiles from selected sites in Minnesota.

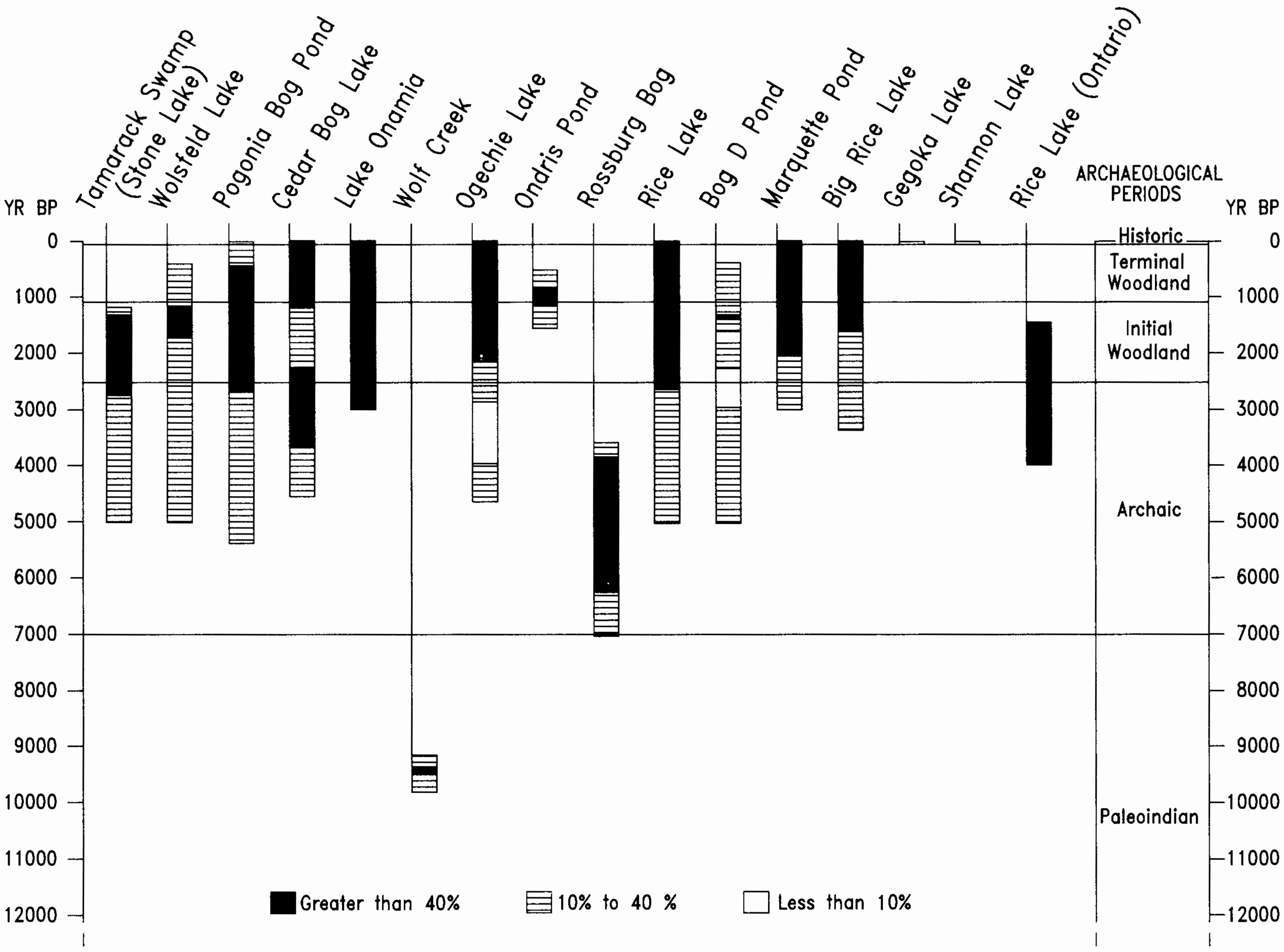


Figure 8. Gramineae pollen sequences from selected sites in Minnesota and Ontario.

expansion of wild rice and the approximate time of expansion.

ARCHAEOLOGICAL IMPLICATIONS

The pollen profiles with greater than 40% Gramineae indicate that wild rice was present in harvestable quantities at various times in the last 10,000 years. (See Figure 8.) Although the harvesting of wild rice is usually associated with the Woodland archaeological period and the advent of ceramics, wild rice was available during all archaeological periods. Based on the palynological evidence, wild rice became more abundant during the Woodland archaeological period. (See Figure 8.) However, this evidence may be the result of site selection rather than the prehistoric abundance of wild rice. Most palynological studies in which a Gramineae rise is attributed to the expansion of wild rice were not undertaken to investigate wild rice but were paleoecological investigations to reconstruct vegetational change in the area. Most sites that have been investigated specifically to understand the history of wild rice have been undertaken at lakes that currently support a large stand of wild rice. There is a problem with this approach, however. Many lakes in the past probably were capable of supporting harvestable quantities of wild rice, but, as sediment continued to infill these lakes, they became bogs and were no longer able to support wild rice, indicating wild rice beds extant during the Paleoindian and Archaic periods may now be infilled. Wolf Creek, Rossburg Bog, Bog D Pond, Ondris Pond, and Pogonia Pond are all good examples of this. On the other hand, as shown in the Gegoka Lake pollen diagram (see Figure 5), current stands of wild rice may not have a very long history.

Wild rice was probably present in the shallows in many of the wild rice lakes investigated prior to its expansion over most of the lake. At Shannon Lake, wild rice is growing in large stands in the bays and shallows and the uppermost lake sediments have a Gramineae pollen percentage value of less than 10%. (See Figure 6.) Therefore, wild rice was probably present in quantities large enough to provide a major food source even though Gramineae pollen profiles would be less than 40%. In lakes that apparently have never supported wild rice, Gramineae pollen profiles are usually less than 10%. Based on the data from Shannon Lake, even lakes with less than 10% Gamineae pollen values may have appreciable stands of wild rice. If one looks at the pollen profiles in which Gramineae percentage abundance is between 10% and 40%, wild rice probably was present in quantities large enough to provide a considerable subsistence component throughout part of the Paleoindian and most of the Archaic periods. (See Figure 8.) Further studies specifically targeting lake deposits that could have supported large stands of wild rice between 10,000 and 4,000 years ago need to be undertaken in order to understand the expansion of wild rice in Minnesota.

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